OBSERVATIONAL CONSTRAINTS ON PLANETS IN THE ALPHA CENTAURI STAR SYSTEM.

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Introduction: The recent discovery of Proxima Centauri b has stirred up great interest in our closest stellar neighbors. At only ~1.3 parsecs away, α Centauri A, α Centauri B, and Proxima Centauri present a unique opportunity for the detection of exoplanets using high quality observations spanning many years. Using radial velocity observations of α Centauri A and B with CHIRON [1], α Centauri B with HARPS [2], and Proxima Centauri with HARPS and UVES [3], we place constraints on the extent to which undetected planetary companions may still exist around these stars.

Methods: CHIRON is a fiber-fed spectrograph with a 2.”7 field of view. The α Centauri A and B components now have a projected separation of less than five arcseconds. We eliminated nights where poorer seeing produced significant spectral contamination and used nightly averages for the velocities on the retained nights. We then simulated radial velocity data for planets with different masses/periods while preserving the cadence of the original observations. The residuals from fitting out the linear, binary-orbit trend in the data were added as noise to simulated velocities, thereby capturing the true errors of our spectrograph. Periodograms of these data were then compared to periodograms of white noise to calculate p-values. A p-value of greater than 99% was considered significant, indicating that were such a planet to exist, the existing data is sufficient to discover it.

Conclusions: Orbital periods longer than two years are dynamically excluded [4,5] and existing radial velocity measurements allow us to rule out the existence of planets with masses down to at least 10 Earth masses for shorter orbital periods (see figure 1). While more massive planets are excluded, the parameter space is wide open for the discovery of more potentially habitable, Earth-like planets. As the projected separation of the stars increases (beginning in 2019), high precision radial velocity measurements may well detect analogs of our Earth in this system.

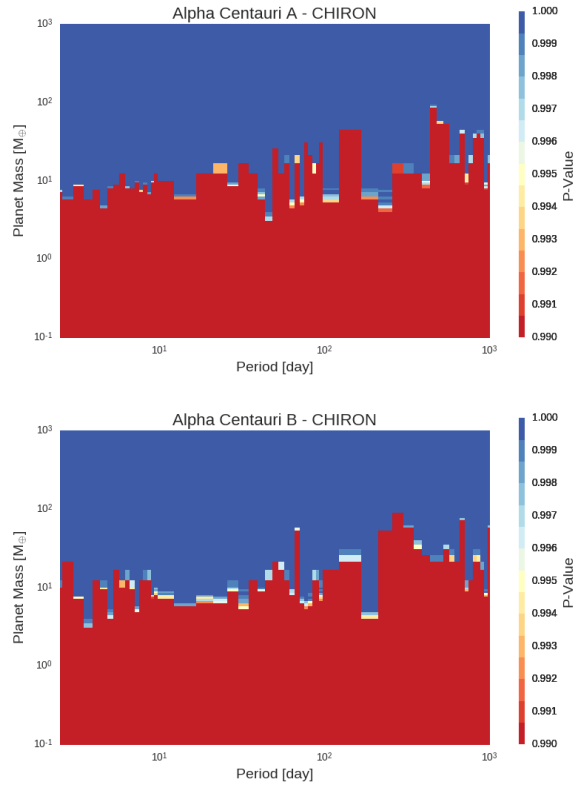

Figure 1: Detectability grids for α Centauri A and α Centauri B using four years of data from CHIRON. Blue coloring indicates higher p-values while redder coloring indicates lower p-values. Dark red covers all areas in which planets may still remain undetected.

References: [1] Tokovinin, A. et al. (2013) *PASP*, 125, 1336. [2] Dumusque, X. et al. (2012) *Nature*, 491, 207. [3] Anglada-Escudé, G. et al. (2016) *Nature*, 536, 437. [4] Weigert, P.A., Holman, M. J. (1997) *ApJ*, 113, 1445. [5] Guedes, J., Rivera, E.J., Davis, E., Laughlin, G. Quintana, E.V., Fischer, D.A. (2008) *ApJ*, 679, 1582.